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INFLUENCE OF THE ENVIRONMENTAL CONTEXT: ASSESSING STREAM WATER QUALITY UNDER CONDITIONS OF MULTIPLE STRESS

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The implementation of the European Water Framework Directive requires ensuring the good chemical and ecological status of streams. River quality is by nature highly variable, considering only basin lithology, vegetation and climate, where especially in small watersheds spatial variations can extend over several orders of magnitude for most major elements. Moreover, changes in land use and land cover, driven by urban expansion and increased agricultural production, have led to multiple chemical stressors impacting surface water resulting in the loss of biodiversity and impairment of ecosystem functions. Thus, although emissions from urban areas are an important factor of concern regarding impacts to stream quality, a more holistic understanding of especially chemical stressors within an entire catchment is crucial to safeguarding and protecting water resources in Denmark and globally.

Conventionally, the monitoring of freshwater systems has been limited to surface water concentrations, where the dominant focus has been on meeting specific water quality criteria – driven by a few (<50) priority chemical compounds. This, however, provides little to no insight regarding the sources and pathways delivering chemicals with the potential to violate environmental quality criteria in a catchment. In addition, knowledge of the state and influence of headwaters, typically defined as first-order perennial streams, on the water quality and flow regime of down-gradient waters is essential for ensuring the sustainable management of water resources at the river basin scale. Headwaters are intrinsically connected to landscape processes, which can influence the supply, transport and fate of water and solutes in watersheds.

In this study, we have therefore investigated the influence of the environmental context, recognizing particularly the importance of the presence of mixed land-use (peri-urban) stream systems for Denmark, where streams serve as the chemical footprint for activities in the catchment integrating the myriad chemical stressors active in the system. We argue that streams are sensitive to a host of pressures, including urbanization impacts, agriculture, deforestation, invasive species, flow regulations and water extraction, that are key to understanding why progress in achieving e.g. good ecological status is still hampered in Denmark and across Europe. Thus, risk management approaches linked to river basin management plans will need to deliver both proactive (e.g. upstream) measures in addition to reactive (e.g. downstream) measures in order to provide a sustainable pathway for improved water resources at reduced environmental and consumptive costs.